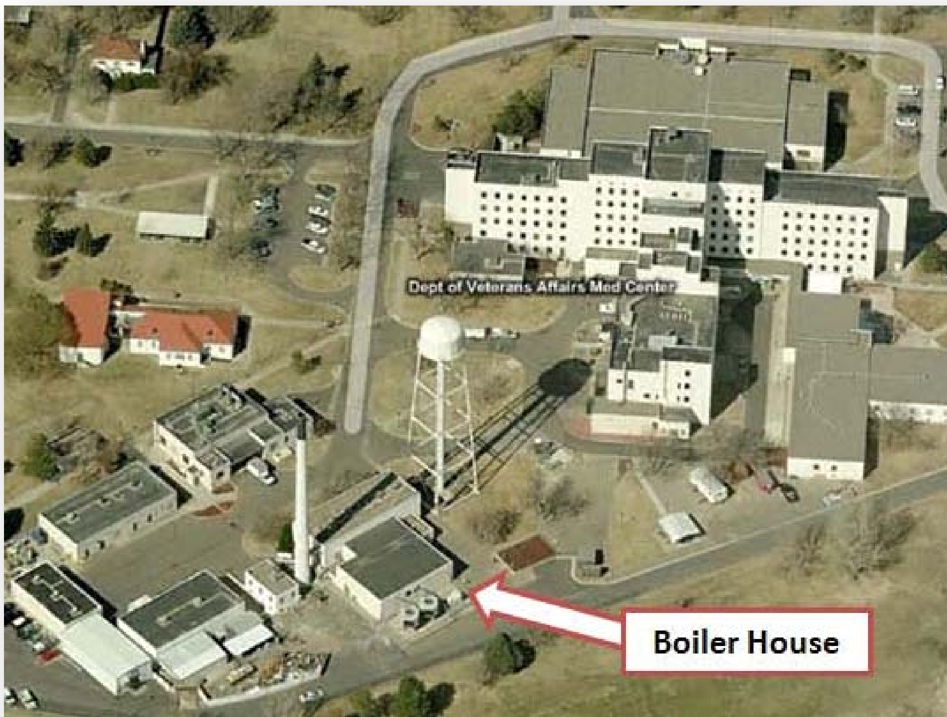
Case Study

GRAND JUNCTION VA MEDICAL CENTER

Introduction

- ANTARES was contracted to study the feasibility of implementing conventional and biomass fueled combined heat and power (CHP) systems at the Grand Junction VAMC
- Purposes
    1. Evaluate potential for reducing energy consumption and/or energy costs
    2. Evaluate the ability of a biomass-based CHP system to meet federal mandates for renewable energy
- Timeline of Study: July 1 – August 30, 2010
- One of 10 such studies recently for VA

Background



- Grand Junction VAMC
  - 22 Buildings
  - Up to ~1,200 patients and employees each day
- Federal Gov't Mandates
  - Reduce energy intensity 30% by 2015 (based on 2003 baseline)
  - 7.5% of Energy Consumption must be from Renewable Sources by 2013
  - GHG reductions

Reasons for Choosing GJ as Case Study

- Technically feasible biomass options
  - Site conditions / space
  - Fuel supply potentially available
    - More due diligence required
  - No environmental show-stoppers
  - One option with positive NPV
    - Only marginally positive
- Go / No-Go decision may well depend on policy applicability
  - Primarily for energy intensity

Data Collection

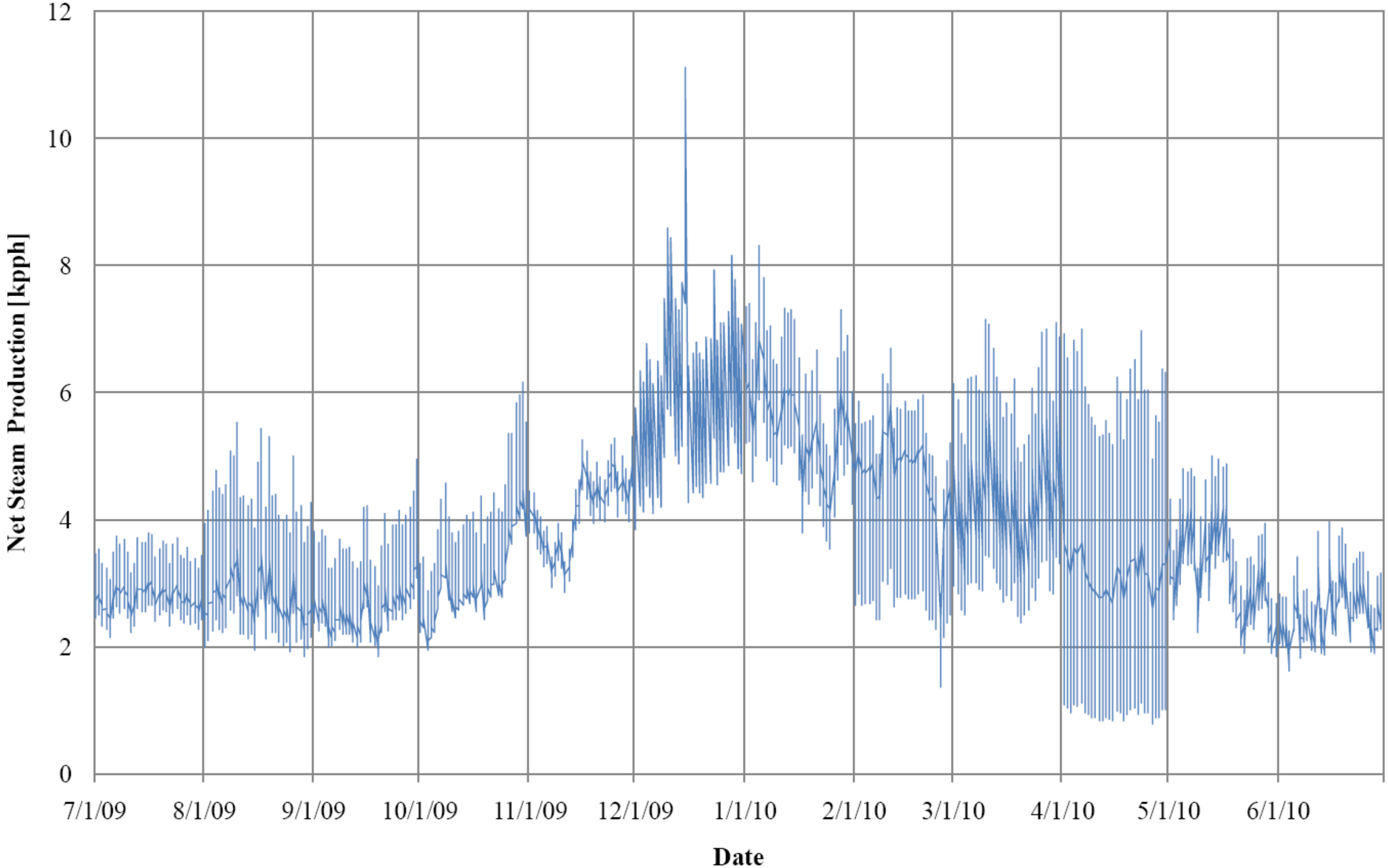
- Steam Data
  - Boiler Logs
  - Steam Production Data
  - Natural Gas Consumption Data
- Electrical Data
  - Electrical Bills
  - Time-of-use Demand Profile Data
- Coincidental Hourly Steam & Electricity Loads
- Site layout, equipment specs, planned replacements
- Planned Expansion Data
  - Building Additions
  - PV Solar Array

Key Energy Usage Characteristics

- Electricity Use:
  - Summer (Max.): 494 MWh
  - Winter (Min.): 367 MWh
  - Total Annual: 4,940 MWh
- Natural Gas Demand:
  - Winter (Max.): 4,645 MMBtu
  - Summer (Min.): 1,818 MMBtu
  - Total Annual: 39,809 MMBtu
- Electricity Costs:
  - $0.068/kWh
  - $336,040/year
- Natural Gas Costs:
  - $8.36/MMBtu
  - $356,206/year
- Electric Demand:
  - Summer (Max.): 975 kW
  - Winter (Min.): 694 kW

Data Analysis

Thermal Load Profile (Steam)



ANTARES Group Incorporated

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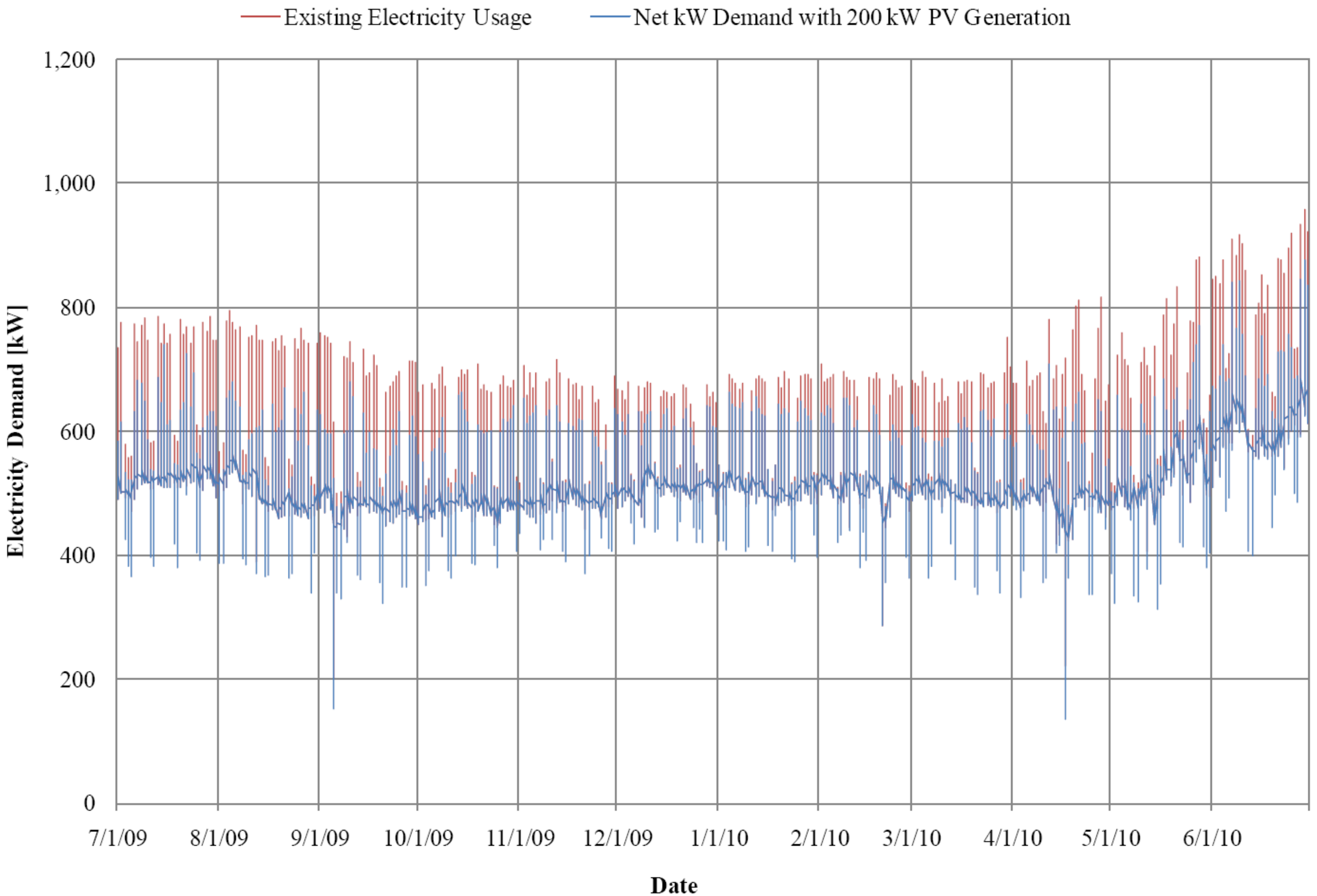
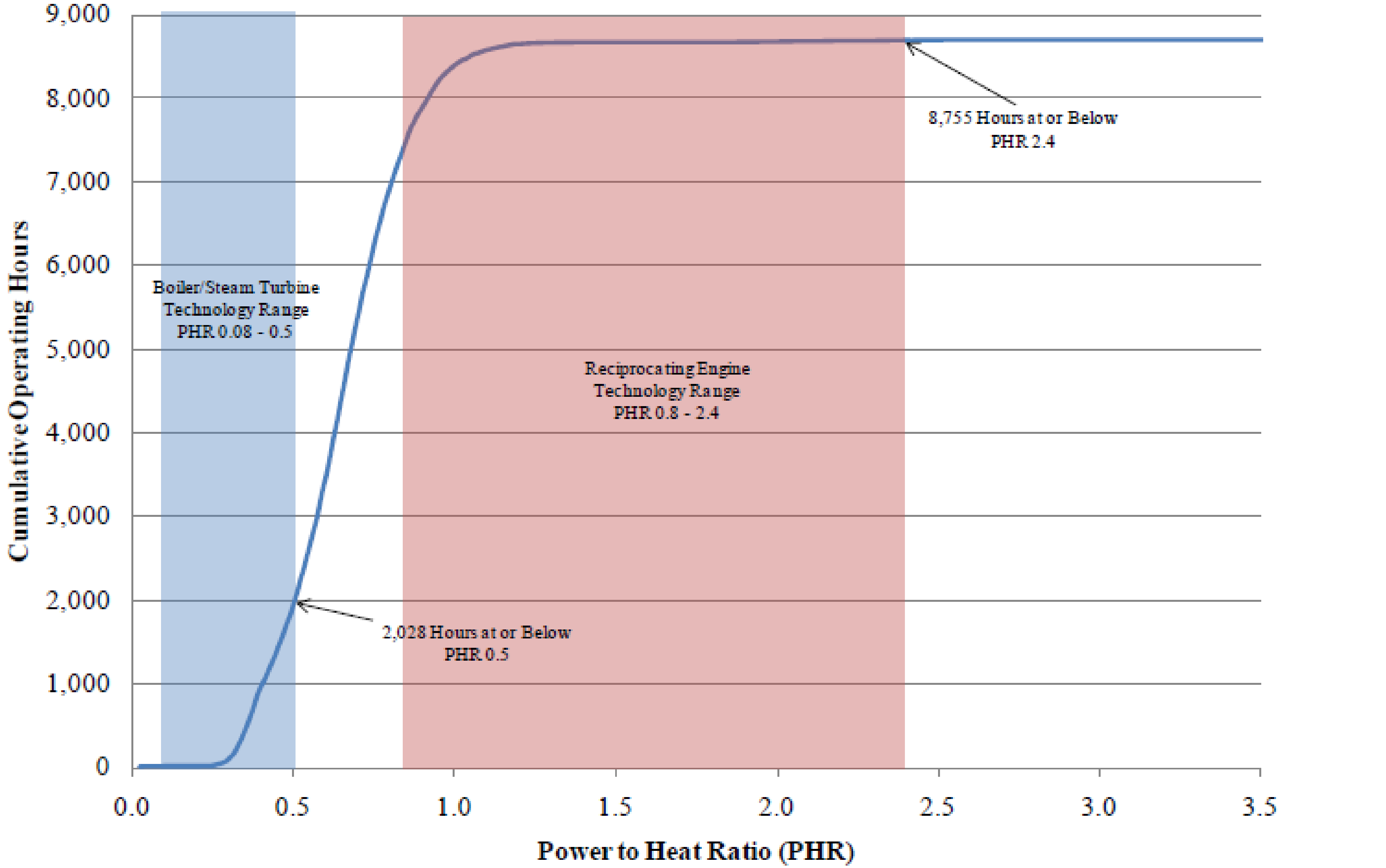
Data Analysis

Electric Load Profile



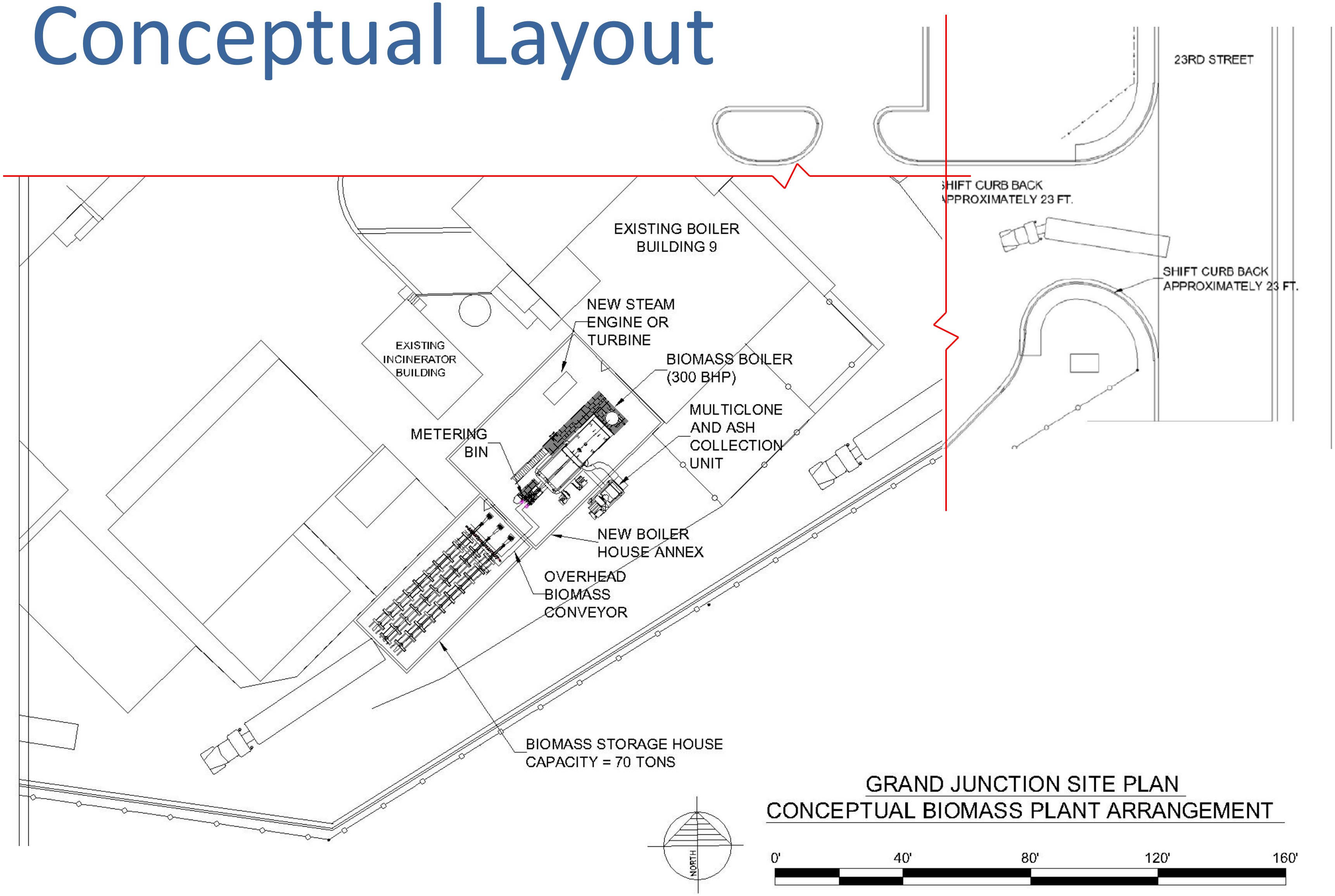
Power to Heat Ratio



Potential Options Considered

1. Biomass-fired Boiler w/ 130 kW Steam Engine
2. Biomass-fired Boiler w/ 100 kW Steam Turbine
3. Biomass-fired Boiler for Heating Only
4. Gas-fired 334 kW Reciprocating Engine Gen Set
5. Gas-fired 830 kW Reciprocating Engine Gen Set
6. Gas-fired 487 kW Turbine

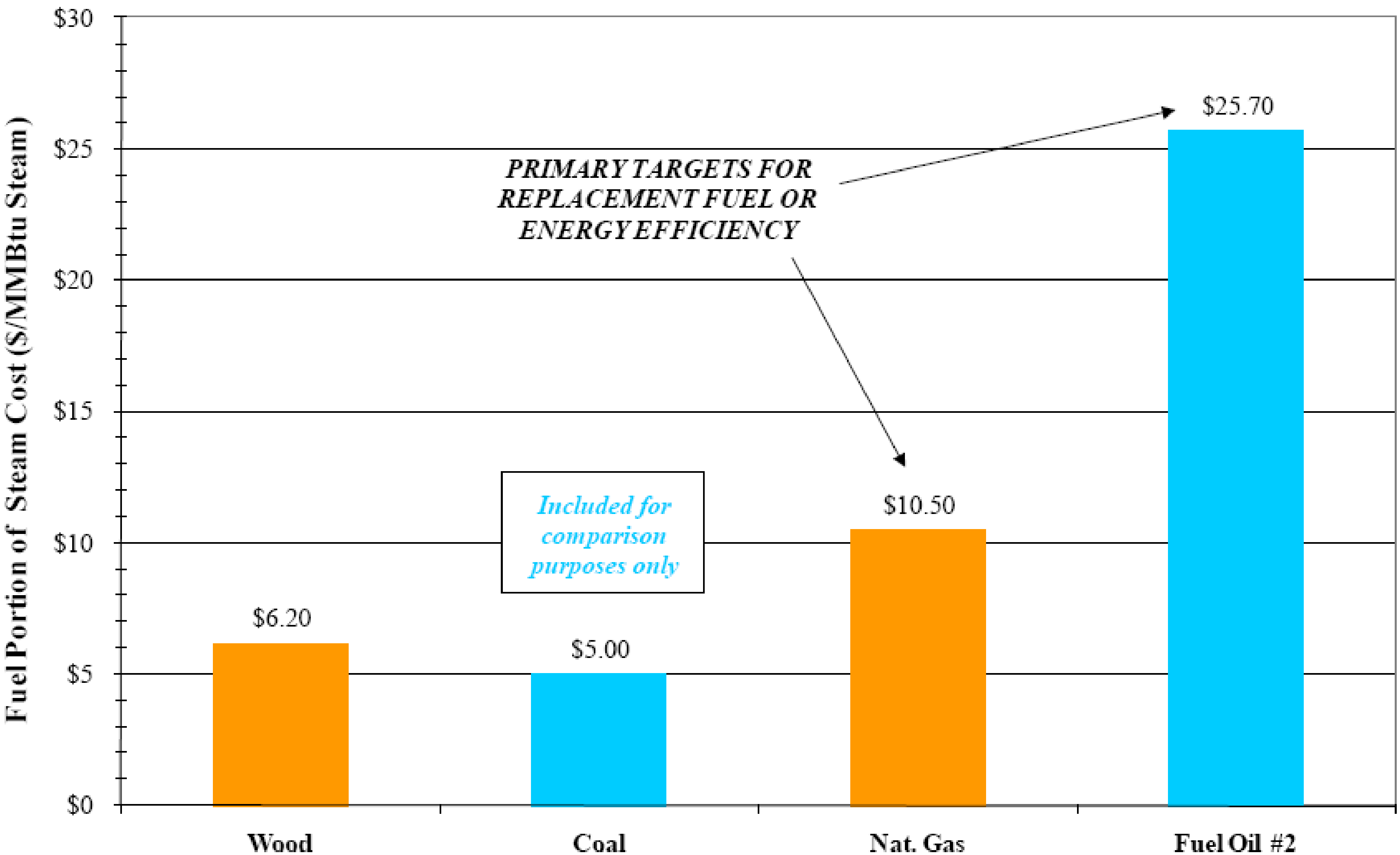
Conceptual Layout



Biomass Resource Assessment

- 44 suppliers were identified, 4 mills responded
- Total available material and estimated price:
  - 7,300 tons/month or **87,600 tons/year**
  - Estimated price = $45/ton
- Grand Junction VAMC Need:
  - **5,700 tons/year**
  - ~1 truck per day during peak season

Relative Fuel Cost of Steam at VAMC



Life-Cycle Economic Comparison

Exhibit 3. LCCA Results – Direct Funding

Cost Component	Existing Facility	Biomass			Conventional		
		Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Total Installed Cost	($750,652)	($2,424,000)	($2,100,000)	($1,304,000)	($2,610,000)	($4,148,392)	($3,614,000)
O&M	($235,610)	($488,398)	($481,995)	($458,444)	($1,075,301)	($2,010,509)	($1,436,795)
Incremental Labor Cost	$0	($1,292,423)	($1,292,423)	($1,292,423)	$0	$0	$0
Energy Cost	($12,093,263)	($9,279,280)	($9,316,318)	($9,944,831)	($11,658,488)	($12,483,199)	($12,021,293)
Life-Cycle Costs	**($13,079,524)**	**($13,484,102)**	**($13,190,736)**	**($12,999,698)**	**($15,343,789)**	**($18,642,100)**	**($17,072,088)**
Net Present Value		($404,578)	($111,212)	$79,826	($2,264,265)	($5,562,576)	($3,992,564)
		130 kW CHP	**100 kW CHP**	**Boiler Only**	**336 kW Engine**	**830 kW Engine**	**467 kW Turbine**

- No attractive conventional (nat. gas-fired) options
- One biomass option with positive NPV
- Biomass options reduce life cycle energy costs by ~ $2.1 to $2.8 million

Potentially Viable Options

- Option 3 – Biomass Boiler for Heating Only (Best Option)
- Option 2 – Biomass Boiler w/ Steam Turbine (2^{nd} Best)
- No conventional options were economically feasible

Exhibit 100. Summary of Financial Indicators for Biomass CHP Options 1, 2, & 3

Financial Indicator	Option 1	Option 2	Option 3
Net Present Value, $	($404,578)	($111,212)	$79,826
Savings-to-Investment Ratio	0.83	0.95	1.06
Adjusted Internal Rate of Return, %	3.14%	3.67%	4.15%
Simple Payback 1, Years	18.00	14.00	8.00
Simple Payback 2, Years	>25 years	>25 years	>25 years

Simple Payback 1: Includes avoided equipment replacement costs in Year 5.

Simple Payback 2: Does not include avoided equipment replacement costs in Year 5 (energy savings only)

Conclusions & Effects on Energy Use Goals

- The Biomass Heating Only Option Would:
  - *Reduce on-site fossil fuel consumption by **85%** using a renewable fuel source*
  - *Results in ~60% of total on-site energy use from a renewable fuel source*
  - *Significant reductions in GHG from on-site energy use*
  - *Reduce on-site energy intensity by more than 70%*
    - *If on-site renewable steam generation does not count towards intensity*
- *Energy intensity goal is a key priority for the VA*
- *Implementation of project will likely hinge on treatment towards energy intensity goals*

Back-up Slides . . . . .

Existing Energy Systems

- Heating Plant
  - Three 6,900 pph Natural Gas-Fired Boilers
- Cooling Plant
  - 200 Ton Trane DX Chiller
  - 200 Ton Absorption Chiller
- Steam Demand includes:
  - Heating, cooling, laundry, sterilization
- Electric Demand includes:
  - Lighting, cooling, miscellaneous

Results from Studies at Other Facilities

Facility Name	Most Viable Option	Project Size (Nameplate Capacity)	NPV Under Direct Funding (With Incentives)
Bob Stump VAMC Prescott, AZ	**Reciprocating Engine** with Steam and Hot-Water Heat	**335 kW**	$1,500,000
Roseburg VAMC Roseburg, OR	**Backpressure Steam Turbine** with 10,350 lb/hr Boiler.	**195 kW**	$(1,750,000)
Grand Junction VAMC Grand Junction, OR	**Biomass Boiler, Steam Only** with 6,695 lb/hr Boiler.	**n.a.**	$79,826
Fort Harrison VAMC Helena, MT	**Biomass Boiler, Steam Only** with 6,695 lb/hr Boiler.	**n.a.**	$(677,575)
S. Oregon Rehab. Center and Clinics White City, OR	**Backpressure Steam Turbine** with 10,350 lb/hr Boiler	**254 kW**	$(22,000)

Federal Policies

Energy Policy Act (EPACT) of 2005

- Federal Government is required to consume 5% renewable energy in FY 2010 to FY 2012, and 7.5% in FY 2013 and each FY thereafter.
- May be met either by purchase of renewable energy certificates, or by generating renewable energy on-site.
- Bonus credit for on-site generation (equivalent to twice the amount for REC purchases)

Energy Independence and Security Act of 2007 (EISA)

- Requires 30% of the hot water demand in new Federal buildings (and major renovations) be met with solar hot water equipment provided it is life-cycle cost-effective.
- Requires new buildings and major renovations of Federal buildings to reduce fossil fuel consumption relative to 2003 by:
  - 55% by 2010
  - 65% by 2015
  - 80% by 2020
  - 100% by 2030
- Makes it easier for Federal agencies to finance renewable energy projects through energy savings performance contracts (ESPCs) through the following:
  - Project funding flexibility is increased by allowing agencies to combine appropriated funds and private financing.
  - Contract length limitations to less than 25 years are also restricted, as are total obligation amount limitations.
  - The definition of ESPC is expanded to include the use of excess electrical or thermal energy generated from on-site renewable sources.

EO 13123 (July 8, 1999): Greening the Government Through Efficient Energy Management

- Reduce GHG emissions attributed to facility energy use by 30% by 2010 relative to 1990 levels.
- Reduce energy consumption per gross square foot of its facilities, by 30% by 2005 and 35% by 2010 relative to 1985.
- Expand the use of renewable energy by implementing RE projects and by purchasing electricity from RE sources.
  - In support of the Million Solar Roofs initiative, strive to install 2,000 solar energy systems at Federal facilities by the end of 2000, and 20,000 solar energy systems at Federal facilities by 2010.
- Reduce the use of petroleum within its facilities by switching to less GHG-intensive, nonpetroleum energy source, (natural gas or renewable energy sources); eliminating unnecessary fuel use; other appropriate methods
- Reduce total energy use and associated GHG and other air emissions, as measured at the source by undertaking life-cycle cost-effective projects in which source energy decreases, even if site energy use increases. In such cases, agencies receive credit toward energy reduction goals through guidelines developed by DOE.
- Reduce water consumption and associated energy use in facilities

EO 13423 : reinforces the legislative renewable goals.

- mandates that at least half of renewable energy used by the Federal Government to meet EPAct 2005 must come from new renewable sources (New means in service after January 1, 1999).
  - Non-electric renewable resources (e.g., solar water heating) can be used to meet this requirement, but all of the EPAct 2005 goal must be met with renewable electricity.
- Reduce Energy Intensity: Federal Government required to reduce its energy use intensity in buildings starting in fiscal year (FY) 2006 by 3% annually through FY 2015 relative to the FY 2003 baseline.

EO 13514: Requires each federal agency to reduce GHG emissions

- Direct on-site emissions (Scope 1)
  - from sources that are owned or controlled by a Federal agency, such as vehicles and equipment, stationary energy generation sources, on-site landfills and wastewater treatment facilities, and fugitive emissions.
- Indirect emissions from utility purchases and other activities (Scope 2 and 3)
  - Scope 2 includes GHG emissions resulting from the generation of electricity, heat, or steam purchased by a Federal agency.
  - Scope 3 includes GHG emissions caused by sources not owned or directly controlled by a Federal agency but are related to agency activities, such as transmission and distribution losses for utility energy, business air travel, employee commuting, and contracted solid waste.

Power to Heat Ratio

VAMC Electrical Load		MM BTU Eq.
Peak Demand (kW)	975	3.3
Average Demand (kW)	800	2.7

VAMC Thermal Load	
Peak Demand (MM BTU)	8.9
Baseload Demand (MM BTU)	2.8

Power to Heat Ratio	
Peak Demand	0.37
Average/Baseload Demand	0.98

Large combined operations facilities with high thermal loads fall between optimal CHP options. Options are:

- Exceed Facility Electrical Demand
- Peak Shave, or marginally offset electrical demand
- Or provide only limited heat recovery for thermal loads